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H4L LDSC

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ONLINE : WPI

(54) Abstract Title
Wireless Internet network architecture

(57) A base station is connected to a central office via a T1/E1 trunk. Some channels of the trunk are assigned to carry PCM data destined for the PSTN via the central office, while other channels of the trunk are assigned to carry packet data destined for the internet via the central office. The base station includes a wireless subscriber interface, a PCM interface, a packet data interface and a selector circuit which selectively couples the subscriber interface to either the PCM interface or the packet data interface.

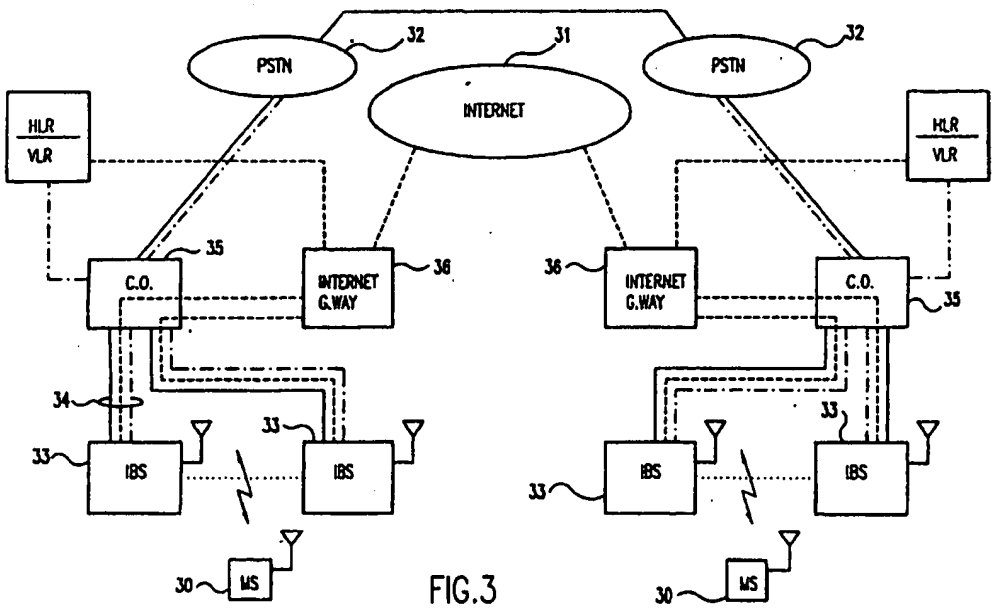

FIG.3

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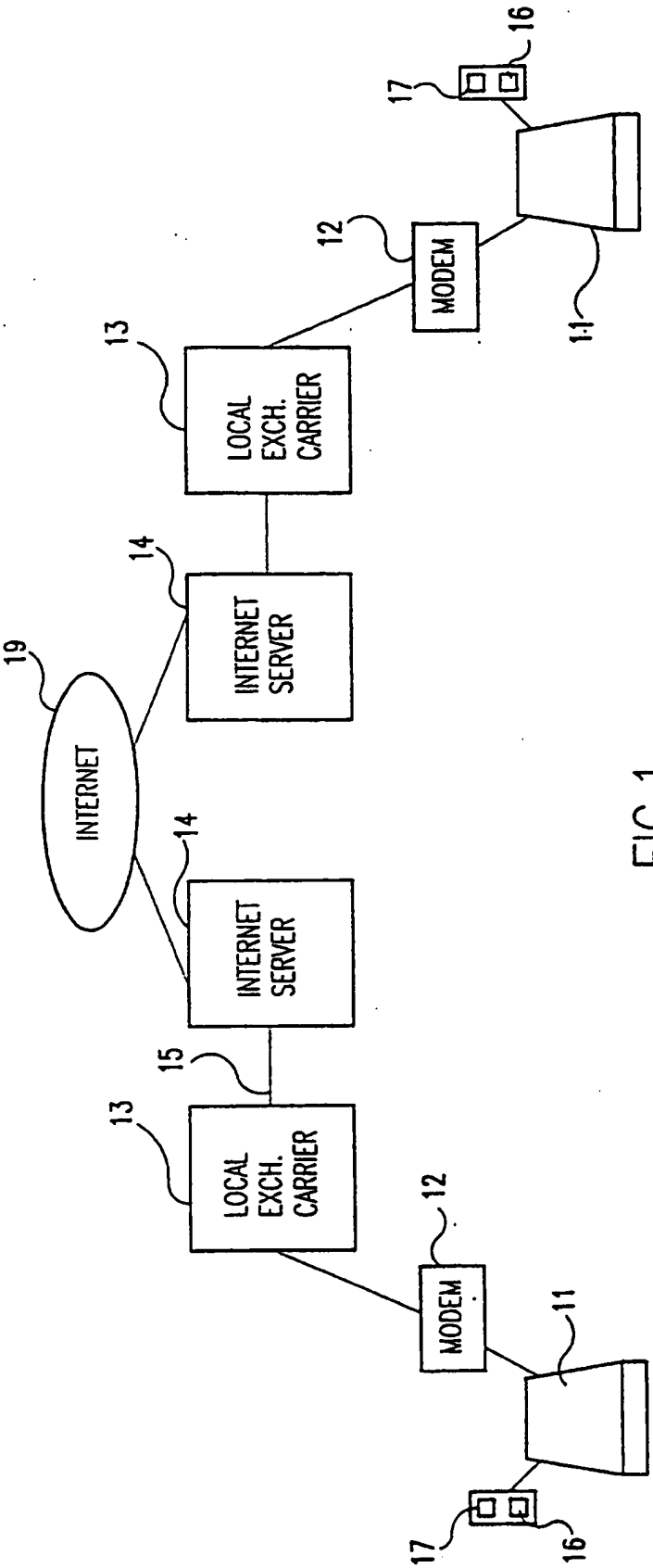

FIG. 1
PRIOR ART

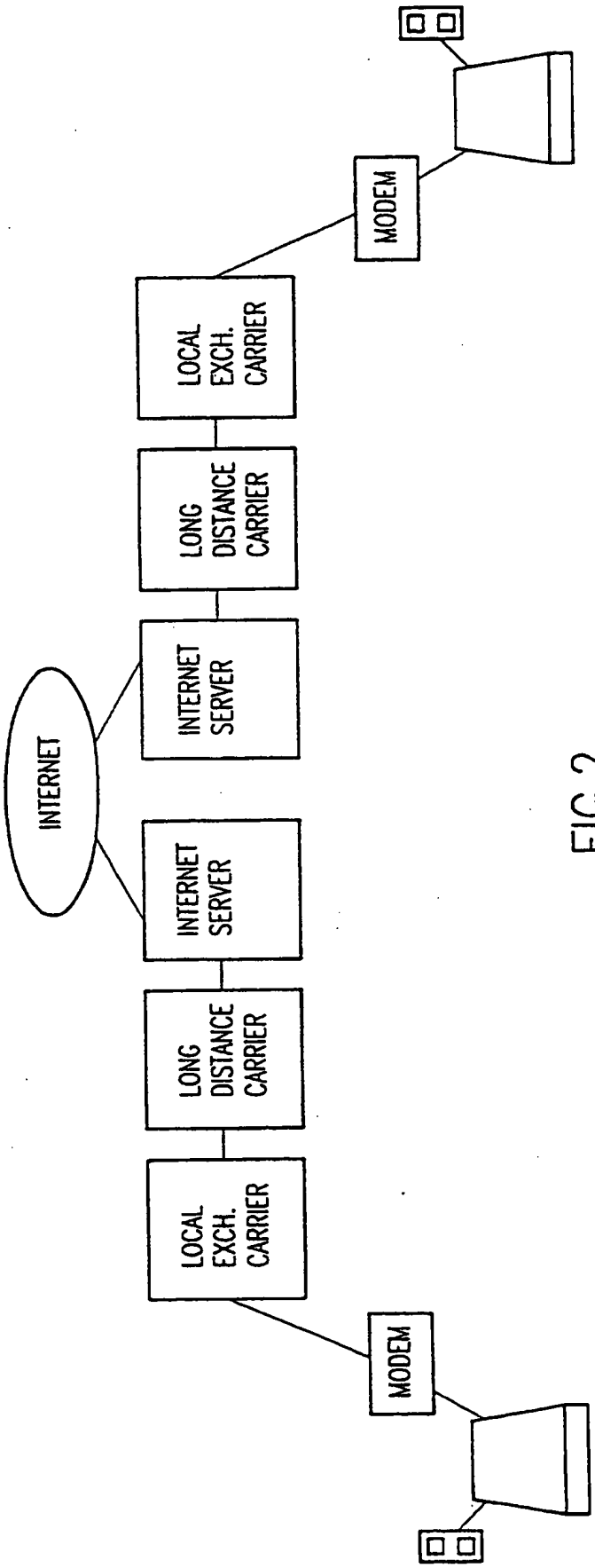

FIG.2
PRIOR ART

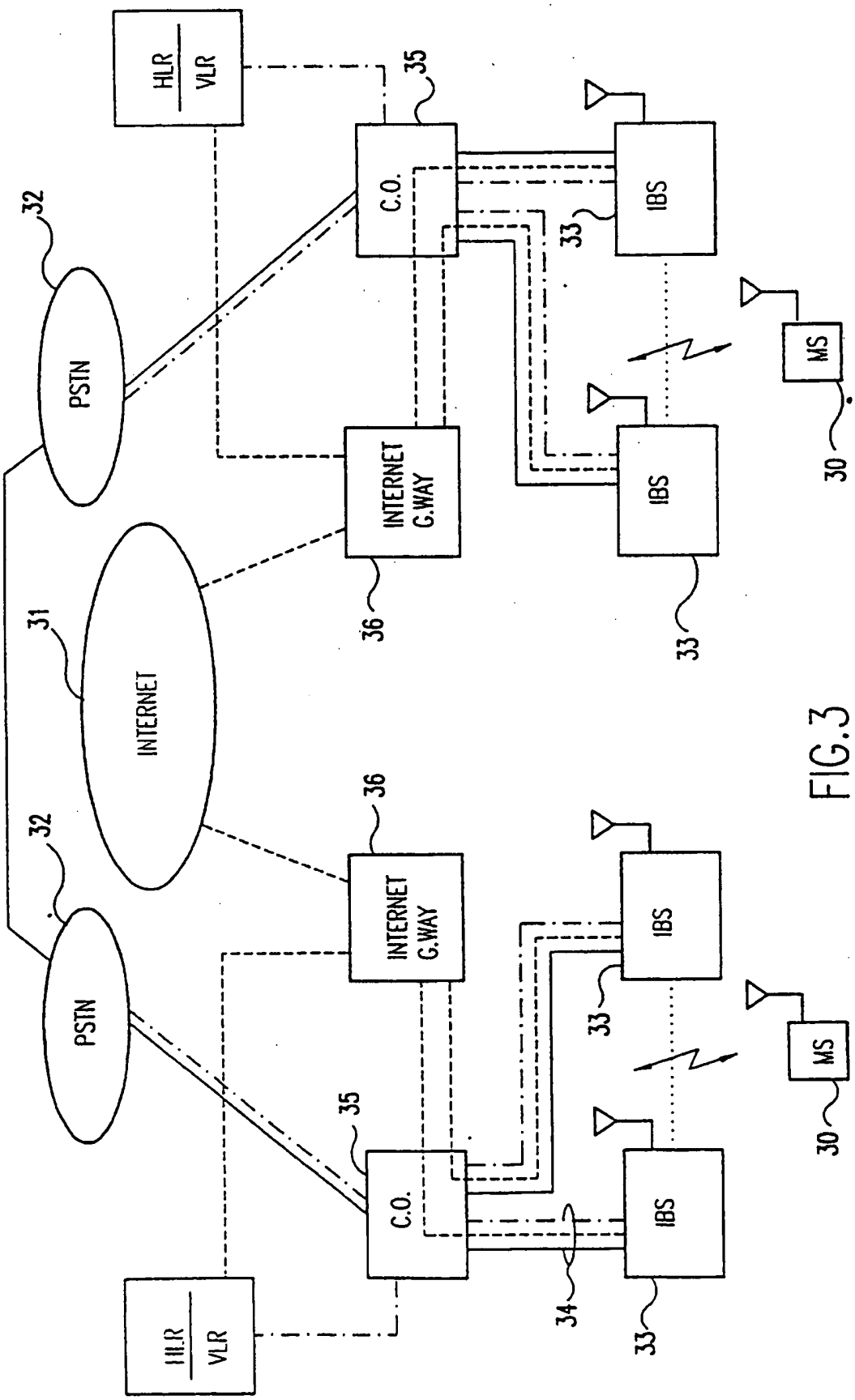
HLR
VLR
35
C.O.
IBS
33
32
PSTN
INTERNET
G.WAY
36
31
INTERNET
MS
30
IBS
33
36
INTERNET
G.WAY
32
PSTN
IBS
33
MS
30
35
C.O.
IBS
34
33
HLR
VLR

FIG.3

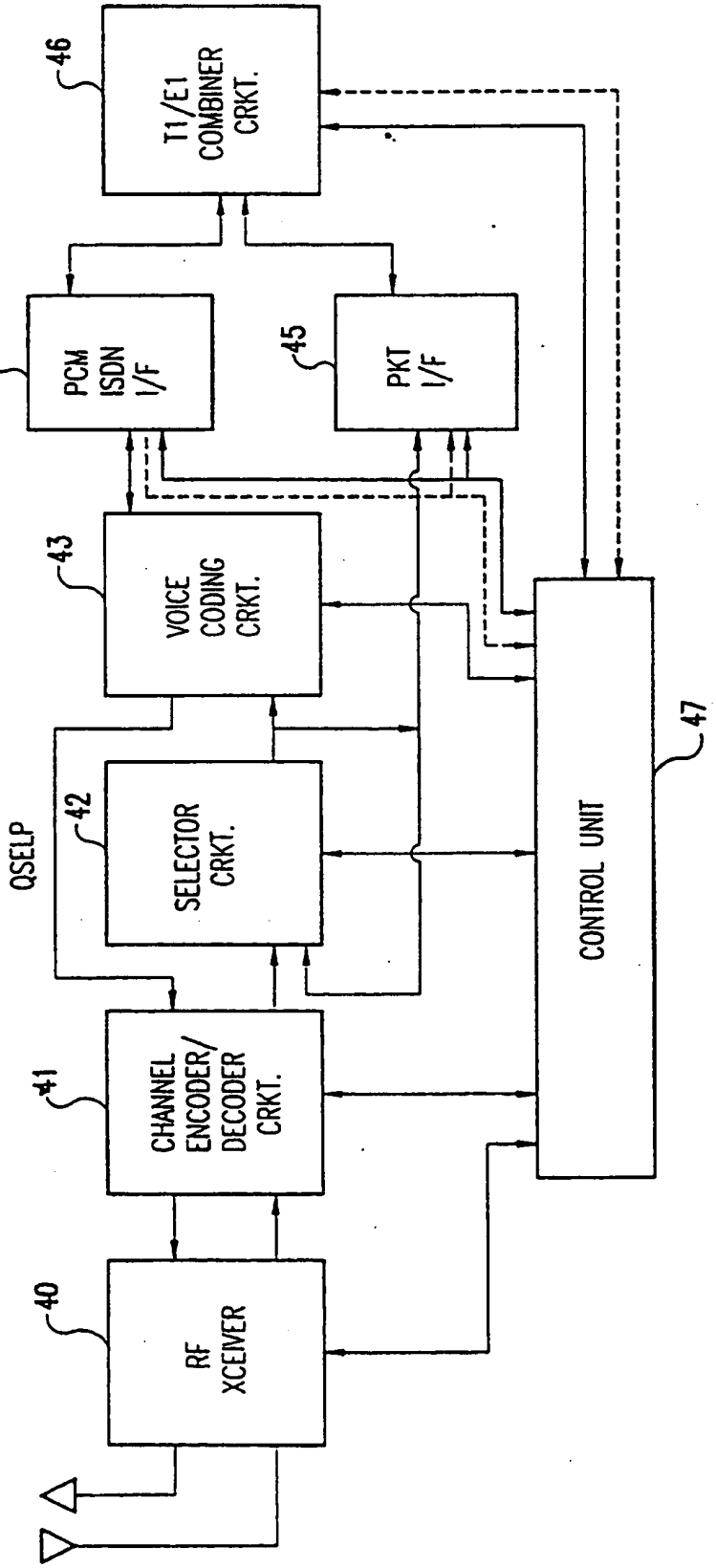
46
T1/E1 COMBINER CRKT.
44
PCM ISDN I/F
45
PKT I/F
43
VOICE CODING CRKT.
QSELP
42
SELECTOR CRKT.
41
CHANNEL ENCODER/ DECODER CRKT.
40
RF XCEIVER
CONTROL UNIT
47

FIG.4

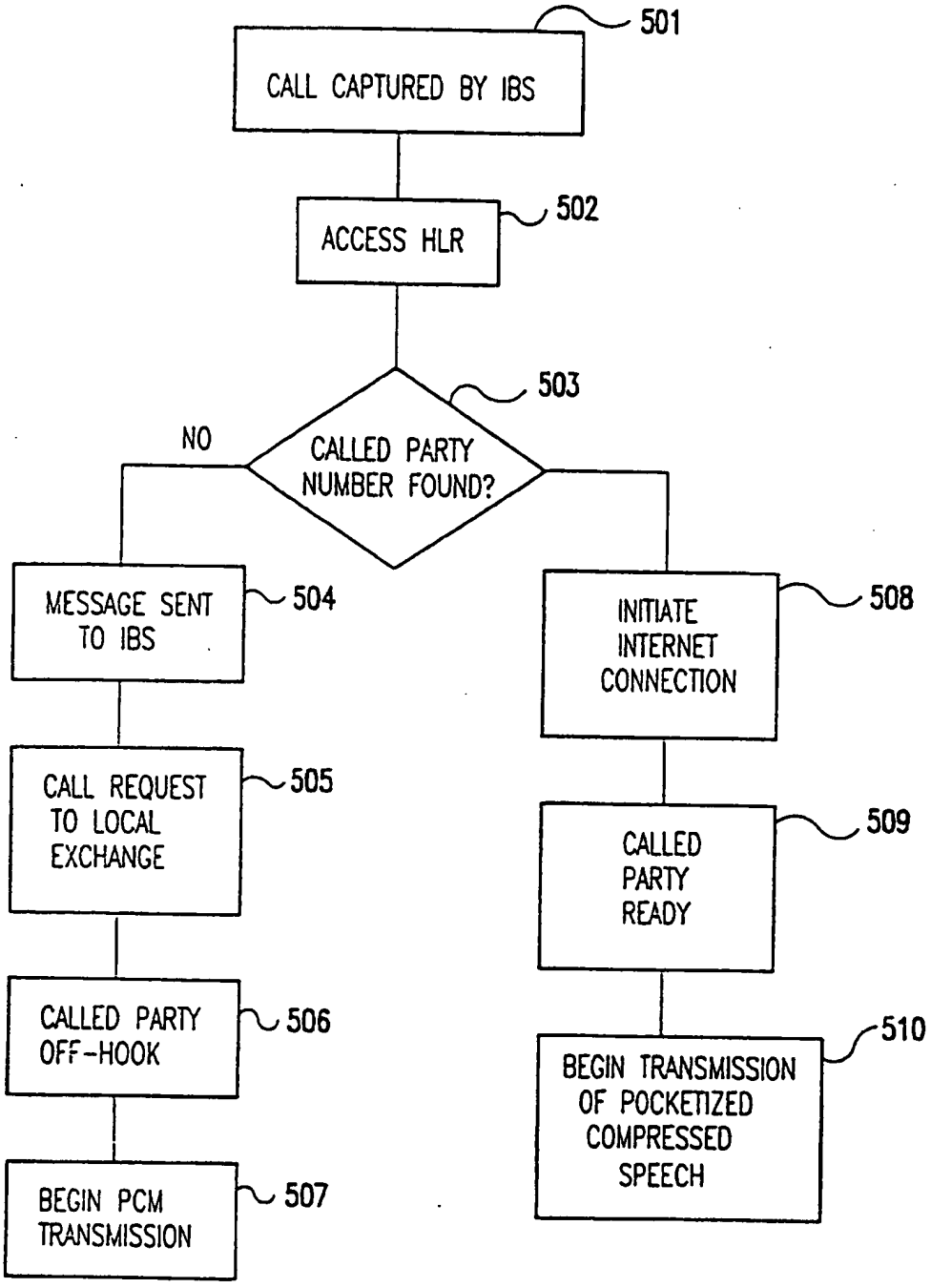
501
CALL CAPTURED BY IBS
502
ACCESS HLR
503
CALLED PARTY NUMBER FOUND?
NO
504
MESSAGE SENT TO IBS
505
CALL REQUEST TO LOCAL EXCHANGE
506
CALLED PARTY OFF-HOOK
507
BEGIN PCM TRANSMISSION
508
INITIATE INTERNET CONNECTION
509
CALLED PARTY READY
510
BEGIN TRANSMISSION OF POCKETIZED COMPRESSED SPEECH

FIG.5

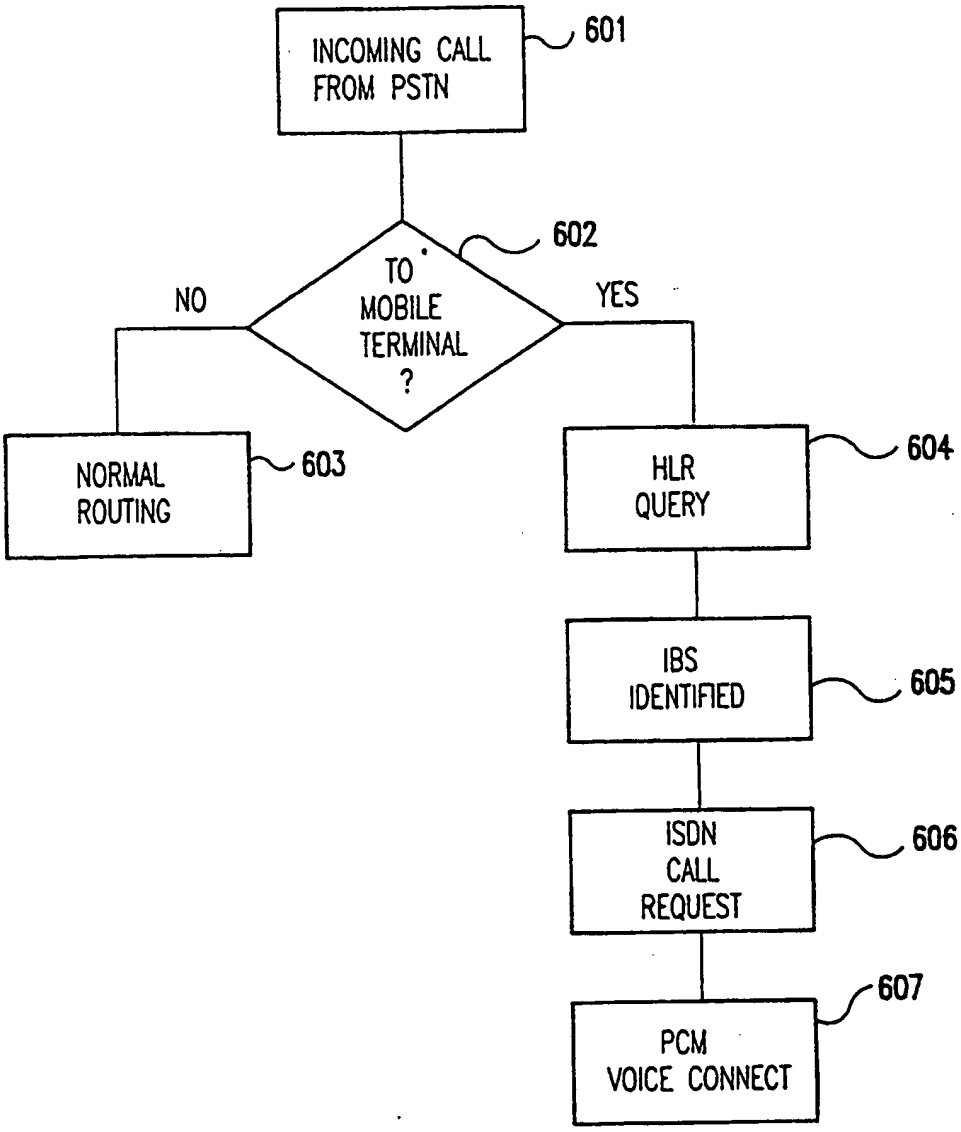
INCOMING CALL FROM PSTN
601
TO MOBILE TERMINAL ?
602
NO
YES
NORMAL ROUTING
603
HLR QUERY
604
IBS IDENTIFIED
605
ISDN CALL REQUEST
606
PCM VOICE CONNECT
607

FIG:6A

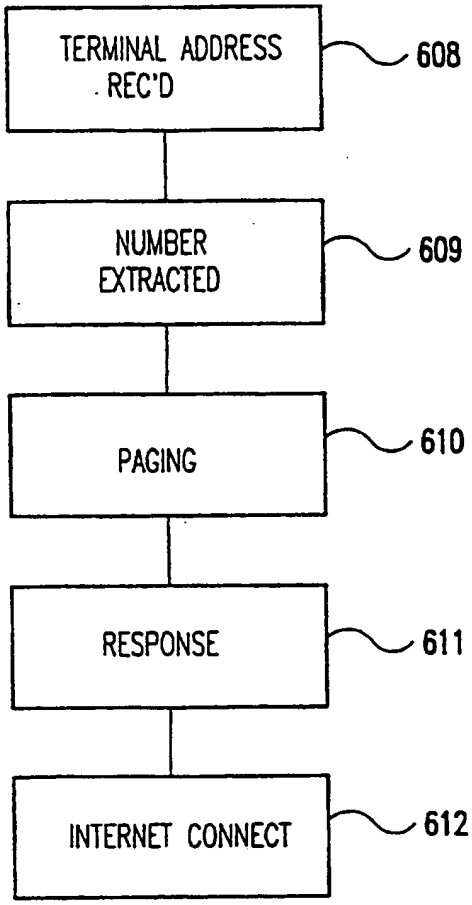
TERMINAL ADDRESS REC'D
608
NUMBER EXTRACTED
609
PAGING
610
RESPONSE
611
INTERNET CONNECT
612

FIG.6B

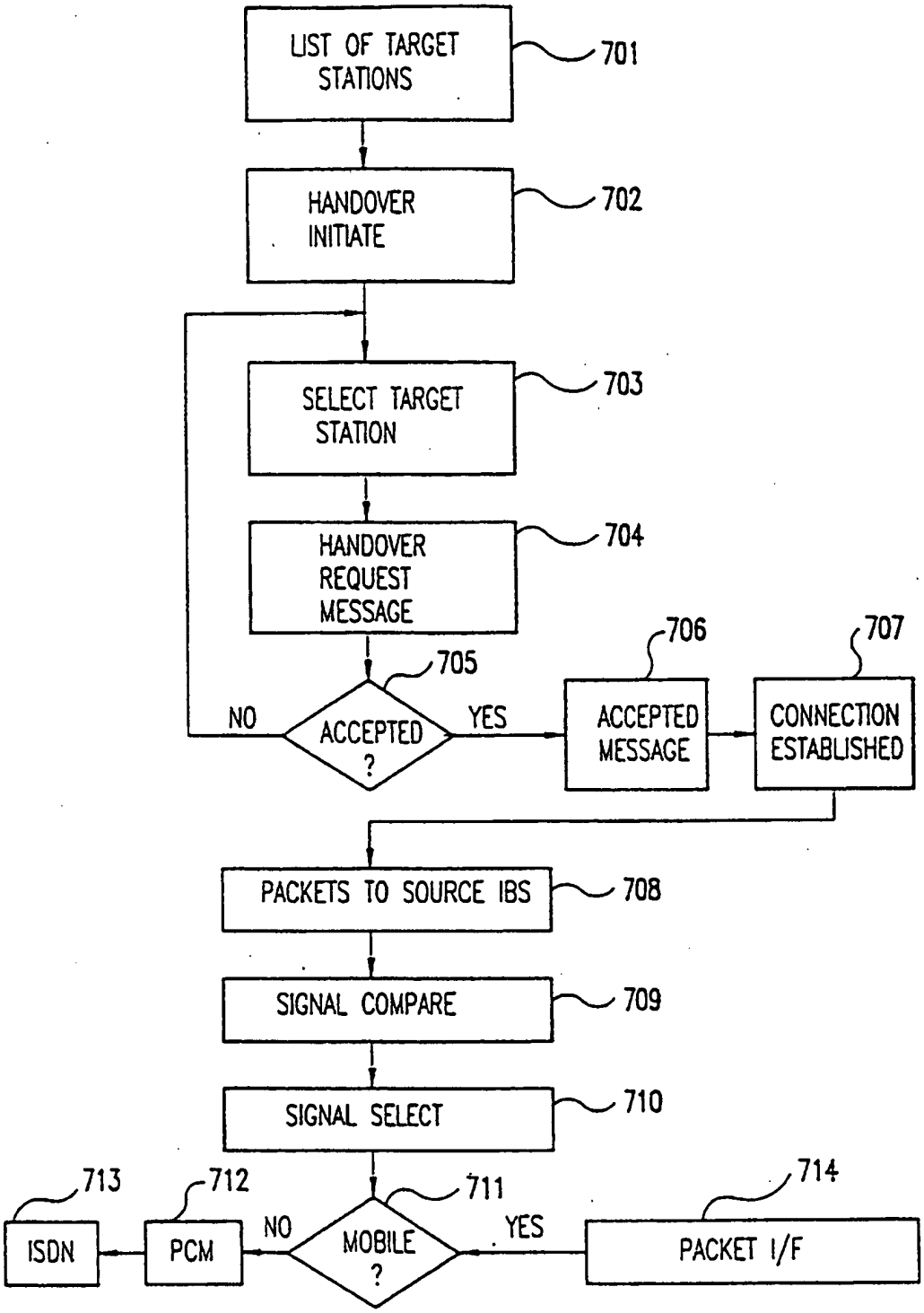
LIST OF TARGET STATIONS
701
HANDOVER INITIATE
702
SELECT TARGET STATION
703
HANDOVER REQUEST MESSAGE
704
705
706
707
NO
ACCEPTED ?
YES
ACCEPTED MESSAGE
CONNECTION ESTABLISHED
PACKETS TO SOURCE IBS
708
SIGNAL COMPARE
709
SIGNAL SELECT
710
713
712
711
714
ISDN
PCM
NO
MOBILE ?
YES
PACKET I/F

FIG.7

WIRELESS INTERNET NETWORK ARCHITECTURE

BACKGROUND OF THE INVENTION

The present invention relates to a network architecture for achieving both voice and data service over the internet, and more particularly, to a network architecture in which plural internet base stations are deployed each having high-capacity trunk connections with central offices for internet and ISDN access and wireless transceivers for subscriber voice and data communication.

The internet phone is known for achieving voice-to-voice communication over the internet. As shown in Fig. 1, this is done by using the facilities of local telephone companies (and sometimes long distance carriers). That is, a first user computer 11 most typically dials via a modem 12 into a local telephone exchange 13. The first computer 11 is equipped with a microphone 16 and a speaker 17. The local telephone exchange 13 routes the "call" (ie modulated voice data) to an internet server 14 which, after establishing two-way communication with computer 11 over the telephone line 15, places packet voice data on the packet switching network of the internet 19. At the far end, the second user computer 11 (also having a modem 12, microphone 16 and speaker 17) similarly establishes two-way communication with another local exchange carrier 13, which in turn connects with an internet server 14. Packet voice data is passed back and forth over the internet between the internet servers 14, which transmit (and receive) modulated voice data to (and from) the respective computers 11. The modems 12 demodulate the modulated voice data for sound reproduction on the speakers 17.

In some cases, as shown in Fig. 2, one or both user computers may require use of long distance carrier lines to connect to an internet server. That is, in some cases the internet server is not directly accessible by the local exchange carrier.

One disadvantage of this conventional scheme resides in the need to use the facilities of the local and sometimes long distance carriers. That is, the tariff structure of such carriers often makes extensive use thereof cost prohibitive. As a separate matter, internet access over cellular/mobile telephone channels is also well known. However, such requires the use of mobile switching centres which in turn are connected to the local exchange carrier and sometimes long distance carrier for routing to an internet server.

SUMMARY OF THE INVENTION

It is an objective of the present invention to provide a network architecture which allows for voice and data communication between subscribers without using facilities of the local and long distance exchange carriers. It is also an objective of the present invention to eliminate the need for the mobile switching centre, and to distribute a handover process carried out as subscribers move from one service area to another. It is still a further objective of the invention to provide a network architecture capable of communication with existing public switched telephone network as well as the new internet based phones. Another objective of the invention is to reduce interconnection costs.

Accordingly, the present invention provides a communications network comprising:

a base station including a subscriber interface, a PCM interface, a packet data interface and means for selectively coupling the subscriber interface to either the PCM interface or the packet data interface; and

at least one central office, adapted to route PCM data from the PCM interface to a PSTN and *vice versa* and to route packet data from the packet data interface to an internet gateway and *vice versa*.

Preferably, the subscriber interface is a wireless transceiver.

Preferably, the base station and the central office are connected *via* a multi-channel trunk, a first group of channels of the multi-channel trunk being assigned to carry the PCM data and a second group of channels being assigned to carry the packet data. The multi-channel trunk may be a T1/E1 trunk.

Preferably, the network further comprises a subscriber location register which stores data indicative of respective subscriber locations and in which the central office is adapted to access the subscriber location register to identify a base station to which the PCM data and/or the packet data is to be routed.

The base station may further include an encoder adapted to encode subscriber signals received *via* the subscriber interface to obtain a subscriber encoded signal and a PCM coder adapted to convert the subscriber encoded signal into the PCM data, the means for selectively coupling the subscriber interface to either the PCM interface or the packet data interface being adapted to receive the subscriber encoded signal and selectively apply it to the PCM coder or the packet data interface.

Preferably, the means for selectively coupling the subscriber interface to either the PCM interface or the packet data interface is adapted to receive remote subscriber encoded signals from the packet interface and the base station further comprises a control circuit adapted to compare the signal quality of the subscriber encoded signal with the signal quality of the remote subscriber encoded signal, to control the means for selectively coupling the subscriber interface to either the PCM interface or the packet data interface to output the remote subscriber encoded signal to the packet data interface when the signal quality of the subscriber encoded signal is within predetermined acceptance parameters relative to the subscriber encoded signal received from the encoder.

The present invention also provides a base station for use in a communications network that includes both a PSTN and the internet, the base station comprising a subscriber interface, a PCM interface, a packet data interface, an encoder adapted to encode subscriber signals received *via* the subscriber to obtain a subscriber encoded signal, a PCM coder adapted to convert the subscriber encoded signal into PCM data and means for selectively coupling the subscriber encoded signal to the PCM interface or the packet data interface.

The means for selectively coupling the subscriber encoded signal to either the PCM interface or the packet data interface is preferably adapted to receive remote subscriber encoded signals from the packet interface and the base station further comprises a control circuit adapted to compare the signal quality of the subscriber encoded signal with the signal quality of the remote subscriber encoded signal, to control the means for selectively coupling the subscriber encoded signal to either the PCM interface or the packet data interface to output the remote subscriber encoded signal to the packet data interface when the signal quality of the subscriber encoded signal is within predetermined acceptance parameters relative to the subscriber encoded signal received from the encoder.

According to the preferred embodiment of the present invention, therefore, local fixed phone lines of the local exchange carrier are bypassed by wireless connections, while long distance carriers' connections are bypassed by the packet switching network commonly known as the internet.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will now be described by way of example with reference to the accompanying drawings in which:

Figs. 1 and 2 are network diagrams for explaining a conventional manner of placing a voice-to-voice call over the internet;

Fig. 3 is a network diagram of the wireless internet architecture of the present invention;

Fig. 4 is a block schematic diagram of the internet base station of the wireless internet architecture of the present invention;

Fig. 5 is a flow chart for explaining an inbound scenario in which a call is originated from an internet base station and thus inbound into the network;

Figs 6a and 6b are flow charts for explaining an outbound scenario in which a call is destined for an internet base station and thus outbound from the network; and

Fig. 7 is a flow chart for explaining a handover process in which a subscriber is passed from one internet base station to another.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 3 illustrates a schematic representation of the wireless internet network architecture of the present invention. The network allows mobile subscribers (MS) 30 to trade voice and data messages with each other over the internet network 31, and to trade voice and data messages with others over the public switched telephony networks (PSTN) 32.

Reference numeral 33 in Fig. 3 is an internet base station (IBS) of the invention and is described in greater detail below. As shown, each IBS 33 is capable of establishing two-way radio communication with any one or more of the plural mobile subscribers 30. Also, one or more IBSs 33 are connected by way of high-capacity T1/E1 trunks 34 to a cental office (CO)35. The channels of each T1.E1 line are designated voice circuits (the solid line) and control circuits (the dot-dashed line) which together from an ISDN line, and data packet circuits (the dashed line) which constitute an internet connection. The central office 35

is in turn connected to both an internet gateway 36 and the public switched telephony network 32. The connection is to the internet gateway 36 is by way of packet data circuits, and the connection to the public switched telephony network is by way of voice and control circuits. The internet gateways 36 are connected in the usual manner to the packet switching network of the internet 31. And finally, databases 37 are provided containing a home location register (HLR) and visiting location register (VLR). As will be explained below, the registers HLR and VLR exchange packet data with the internet gateway 36 and control data with the central office 35.

An embodiment of the internet base station 33 (Fig. 3) is shown in Fig. 4. An RF front end transceiver 40 transmits and receives high-frequency radio signals to and from the mobile subscribers 30 (Fig. 3). A channel encoder/decoder circuit 41 encodes received RF control and traffic signals and decodes the control and traffic signals. IN the embodiment, the QSELP signals are CDMA compressed voice coded signals at 8 or 13.3 kbps. A selector circuit 42 receives a first encoded signal from the encoder/decoder circuit 41 and a second signal from a packet I/F circuit 45, and, under control of a control circuit 47 (as described in more detail below with reference to Fig. 7), selectively applies one of the signals to a voice coding circuit 43 or to the packet I/F circuit 45.

The voice coding circuit 43 converts an encoded QSELP signal from the selector circuit 42 into a pulse code modulation (PCM, typically A or μ law) signal, and vice versa. A PCM/ISDN interface (I/F) 44 is interposed between the voice coding circuit 43 and a T1/E1 combiner circuit 46 combines the PCM signals or the packet signals and control signals onto the channels of the T1/E1 trunk line 34 (Fig. 3) connected to the central office 36 (Fig. 3). The control unit 47 (e.g. central processing unit) receives and transmits various control signals from and to the circuits

40-46 to control the overall operation (as described below) of the internet base station.

Referring now to the flow charts of Figs.5-7, the operation of the wireless internet network of the invention will now be described.

Fig. 5 depicts the scenario when a mobile subscriber places (initiates) a call by dialling a destination number which is captured by the internet base station. (Step 501).

The control unit 47 initially accesses the home location register HLR (and/or visiting location register VLR) via the T1/E1 combiner circuit to request identification of the called party number and to determine the last known location of the called mobile subscriber. (Step 502). If the requested called party number is not found in the HLR, the HLR sends back the appropriate message to the IBS. (Steps 503 and 504). In this case, the call request is considered by the IBS as a mobile-to-land line equipment directed call. The IBS connects this call request to the local exchange via an ISDN connection provided by a local exchange carrier. (Step 505). When the called party goes off-hook (step 506), the connection is established and the IBS begins transmission of 64 kbps PCM voice towards the called party. (Step 507). From this standpoint, all aspects of the call are handled like a standard ISDN voice or data call.

On the other hand, when the IBS's request to the HRL is returned with a positive acknowledgement, the called party is reachable via internet connection. In this case, the IBS initiates and internet based voice call connection. (Step 508). When the call set-up procedure indicates that the called party is ready for conversation (step 509). At the same time, the called party is doing the same in the calling party's direction.

Referring now to Fig. 6a, when a call request arrives to the local exchange (central office) from the public switched telephony network (step 602), the local exchange looks into its own database to determine whether the called number is a standard call for a fixed terminal attached to the switch or something special, like a mobile terminal. (Step 602). If it is not a mobile terminal, then the call proceeds in the known manner. (Step 603). If it is a mobile terminal, the National IN capability of the ISDN switches triggers a query of the HLR. (Step 604). The HLR identifies the IBS which contains the last known location of the called mobile subscriber. (Step 605). Based on this information, the local exchange initiates an ISDN call request to the identified IBS (step 606) which turns this request into a paging request for the called mobile subscriber. If the mobile subscriber responds to the paging request, the connection is established using 64 kbps PCM voice. (Step 607).

Fig. 6b is for describing an internet based call request. Such a call is delivered to the right IBS since, as described above (step 502, Fig. 5), the originating IBS queries the HLR for the last known location of the called mobile subscriber. The HLR response to the query contains the internet address of the called party's IBS. Thus, the destination IBS (ie the called party's IBS) directly receives a message from the initiating IBS together with the called party's terminal address. (Step 608). When the called party's serving IBS receives the request, it extracts the called party's number (step 609) and turns it into a paging message. (Step 610). When the called mobile subscriber responds to the page (step 611), the IBS connects the called subscriber by way of the internet connection to the central office using compressed speech packets.

The handover scenario will now be described with reference to Fig. 7. When a mobile subscriber leaves the coverage area of the serving IBS (ie the "source" IBS), a handover

must occur in order to provide uninterrupted service to the user. Based on transmission signal parameters, the mobile subscriber is continuously communicating a list of target stations which represents its view of the best potential serving IBS's to the source IBS. (Step 701). When the source IBS decides that a handover is in order (step 702), the source IBS selects the best target station from the mobile subscriber provided list (step 703) and sends to that station a handover request message via its internet connection (step 704). the target IBS may or may not accept the request (step 705). If the target IBS does not accept the request, a next most favourable target station is selected (step 703) by the source IBS and a handover request is transmitted thereto (step 704).

If the target IBS accepts the request, it sends an accept message (step 706) and immediately tries to acquire the mobile subscriber. When the connection is established (step 707), the target IBS sends its incoming packets of the target IBS are passed through the packet I/F 46 and applied as an input to the selector circuit 53. Under control of the control unit 47, the source IBS compares the quality of the channel encoded signal received from the encoder/decoder circuit 42 and the signal received from the packet I/F 46 (step 709). The best quality signal is selected and output from the selector 43 (step 710). If the called party is a fixed terminal on the public switched telephone network, the selected best quality signal is applied to the voice coder 43 where it is pulse code modulated (steps 711 and 712) and transferred to the local switch via the ISDN line (step 713). On the other hand, if the called party is another mobile subscriber, the best quality signal is directly applied without compressing speech to/from PCM conversion to the packet I/F 46 for transmission via the internet connection (step 714).

When the mobile subscriber is firmly under control of the target IBS, the target IBS instructs the source IBS to release all radio resources for other uses, except the

selector and interface connections which are used as long as the call exists.

CLAIMS

1. A communications network comprising:

a base station including a subscriber interface, a PCM interface, a packet data interface and means for selectively coupling the subscriber interface to either the PCM interface or the packet data interface; and

at least one central office, adapted to route PCM data from the PCM interface to a PSTN and *vice versa* and to route packet data from the packet data interface to an internet gateway and *vice versa*.

2. A communications network according to claim 1 in which the subscriber interface is a wireless transceiver.

3. A communications network according to claim 1 or claim 2 in which the base station and the central office are connected *via* a multi-channel trunk, a first group of channels of the multi-channel trunk being assigned to carry the PCM data and a second group of channels being assigned to carry the packet data.

4. A communications network according to claim 3 in which the multi-channel trunk is a T1/E1 trunk.

5. A communications network according to any preceding claim further comprising a subscriber location register which stores data indicative of respective subscriber locations and in which the central office is adapted to access the subscriber location register to identify a base station to which the PCM data and/or the packet data is to be routed.

6. A communications network according to any preceding claim in which the base station further includes an encoder adapted to encode subscriber signals received *via* the subscriber interface to obtain a subscriber encoded signal and a PCM coder adapted to convert the subscriber encoded signal into the PCM data, the means for selectively

coupling the subscriber interface to either the PCM interface or the packet data interface being adapted to receive the subscriber encoded signal and selectively apply it to the PCM coder or the packet data interface.

7. A communications network according to claim 6 in which the means for selectively coupling the subscriber interface to either the PCM interface or the packet data interface is adapted to receive remote subscriber encoded signals from the packet interface and the base station further comprises a control circuit adapted to compare the signal quality of the subscriber encoded signal with the signal quality of the remote subscriber encoded signal, to control the means for selectively coupling the subscriber interface to either the PCM interface or the packet data interface to output the remote subscriber encoded signal to the packet data interface when the signal quality of the subscriber encoded signal is within predetermined acceptance parameters relative to the subscriber encoded signal received from the encoder.

8. A base station for use in a communications network that includes both a PSTN and the internet, the base station comprising a subscriber interface, a PCM interface, a packet data interface, an encoder adapted to encode subscriber signals received *via* the subscriber to obtain a subscriber encoded signal, a PCM coder adapted to convert the subscriber encoded signal into PCM data and means for selectively coupling the subscriber encoded signal to the PCM interface or the packet data interface.

9. A base station according to claim 8 in which the means for selectively coupling the subscriber encoded signal to either the PCM interface or the packet data interface is adapted to receive remote subscriber encoded signals from the packet interface and the base station further comprises a control circuit adapted to compare the signal quality of the subscriber encoded signal with the signal quality of the remote subscriber encoded signal, to control the means

for selectively coupling the subscriber encoded signal to either the PCM interface or the packet data interface to output the remote subscriber encoded signal to the packet data interface when the signal quality of the subscriber encoded signal is within predetermined acceptance parameters relative to the subscriber encoded signal received from the encoder.

10. A base station according to claim 8 or claim 9 in which the subscriber interface is a wireless transceiver.

11. A communications network substantially as described with reference to and/or as illustrated in FIGs. 3-7 of the accompanying drawings.

12. A base station substantially as described with reference to and/or as illustrated in FIGs. 3-7 of the accompanying drawings.

The Patent Office

Application No:	GB 9724522.9	**Examiner:**	Ken Long
Claims searched:	1 to 12	**Date of search:**	20 February 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): H4K (KOA, KTM, KTK, KYX & KF42)
H4L (LDSC)

Int Cl (Ed.6): H04Q (7/20, 7/22 & 7/24)
H04L (12/56 12/64 & 12/66)

Other: ONLINE : WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2316266 A	IBM (whole document - see for example page 10 line 9 to page 11 line 19)	1 and 6 at least
A	GB 2315190 A	MITEL	None

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.